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WATER QUALITY AND HYDROLOGY OF THE BIGHEAD RIVER GREY COUNTY

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Water Quality and Hydrology
# of the
Bighead River
Grey County

Water Resources Assessment Unit
Technical Support
Southwestern Region

Field Work - 1980
Report Preparation - 1982

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1.0 SUMMARY, DISCUSSION AND CONCLUSIONS

The Bighead watershed is one of the highest quality watersheds in the Southwestern Region of Ontario. The watershed has good base flow conditions, and much of the watershed is characterized by cool, clear streams which provide good trout habitat. In general, the watercourses are favorably low in plant nutrients; hence there are no aesthetic problems resulting from excessive plant growths. The Rocklyn Creek tributary, Walters Creek tributary, as well as the main Bighead River upstream from Bognor, are of particularly high quality and support excellent invertebrate communities. Unlike most of the water quality parameters, bacteria levels tend to be unfavorably elevated throughout most of the watershed. These elevated levels are no doubt a result of a considerable livestock population. In many areas, livestock have direct access to the streams.

In localized parts of the watershed, land use activities have impaired water quality. For example, the cultivation and livestock pasturing practises on the Minniehill Creek sub-watershed have resulted in a warm, more turbid stream with reduced base flows. Also, the recent agricultural drain in the Rocklyn area of Rocklyn Creek was found to destroy what had been a high quality headwater area.

In future, the general quality of the Bighead watershed will depend on three primary factors: (i) the amount of cultivated farm acreage in the watershed, (ii) the degree of soil conservation practiced by the farmers, and (iii) the adequacy of livestock and manure management. Water quality can be kept constant with an increase in cultivation if good soil conservation measures are adopted. These conservation measures are necessary not only in order to preserve stream quality. They also are necessary to maintain a good depth of fertile topsoil on the agricultural lands to support future farming operations. Soil conservation techniques could include some or all of the following, depending on the characteristics of each particular farm.

(a) conservation tillage (e.g. chisel ploughing) and cross-slope tillage
(b) grassed waterways
(c) leaving natural vegetation buffers along streams
(d) leaving wetland areas and hills and erodable areas out of row crop production
(e) good manure management
(f) controlled cattle access
(g) good drain construction (e.g. flatter side slopes and promoting early vegetative cover)
(h) maintaining natural buffer strips between farmyards and watercourses
(i) strip cropping and crop rotations

All of these conservation measures are currently receiving greater attention by farmers throughout Southern Ontario. Controlled experiments in a variety of watersheds including the Palouse watershed in Washington, the Honey Creek watershed in Ohio, and the Avon River watershed in Southwestern Ontario are being carried out to evaluate these conservation measures using a benefit/cost approach. In general, the findings are that the majority of existing soil erosion problems can be greatly reduced without expensive cost to the farmer over the short term. Over the long term, it is becoming more apparent that minimizing soil erosion is essential in order to maintain adequate depths of fertile and well-textured topsoil for future generations.

Technical assistance and subsidies for erosion control are available through the Conservation Authorities, or the Ministry of Agriculture and Food. The latter agency has established a Farm Productivity Incentive Program which provides grants for erosion control measures and improvements to manure handling systems.

The recent studies of PLUARG (Pollution from Land Use Activities Reference Group) have demonstrated that many of the pollutants in the watercourses (e.g. phosphorus, nitrogen, bacteria, metals) are transported with soil particles. Hence, erosion control, keeps watercourses relatively free of pollutants for downstream users.

As outlined above, the environmental character and usefulness of the Bighead in the near future will depend on agricultural conservation. In the distant future, however, extractive operations could become more significant. Large scale extraction of the major gravel deposits in the basin could potentially alter the hydrology of the basin. The present high quality of the fishery and general biological character of the watershed is largely a result of good base flows. Any major extractive operation, with accompanying dewatering could lower water tables and base flows and have a serious impact on stream ecology.

RECOMMENDATIONS

1. Farmers throughout the Bighead watershed should be encouraged to utilize soil conservation measures outlined in the Summary and Conclusions section. Such encouragement should be enhanced by technical and funding assistance available through the Farm Productivity Incentive Program of the Ministry of Agriculture and Food and erosion control programs of the North Grey Region Conservation Authority.

2. The impact of any future major aggregate extractive operations on the flow regime and related quality of the Bighead River should be carefully assessed.

3. Specific farms identified during the course of this study that are contributing contaminants to the Bighead River as a result of improper manure handling or storage practices should be subject to follow-up assessment. The co-operation of the farmers concerned should be solicited in implementing necessary corrective actions.

2.0 INTRODUCTION

Watershed studies are periodically carried out by the Ministry of the Environment. These studies establish an information base for future water resource management, and for any needed pollution abatement activities. Watershed studies can be generalized investigations carried out by the Ministry regional office, or they can be more technical in-depth evaluations carried out by the Ministry's head office with regional assistance.

A generalized survey of the Bighead watershed was carried out in 1980 to document existing quality and to focus attention on any developing water resource problems. The study incorporated historical parameters of concern such as suspended solids, temperature, nutrients and bacteria. Parameters of more recent concern such as stable organic compounds and metals, were not included in this study as these parameters are likely of little or no concern on the Bighead River.

The Bighead flows into Georgian Bay at Meaford (see Figure 1). It drains an area of 340 square kilometers. The Town of Meaford at the river's mouth (population 4,200) is the only sizable urban development on the watershed. The major land use on the watershed is agriculture. The percentage of land under cultivation and row crop production varies considerably throughout the basin. The Minniehill Creek area, for example, has a significant percentage of row crops, while agriculture in the Walter's Creek area remains in a less intensive state. The physiography of the watershed, as described by Chapman and Putnam (1967) is largely drumlinized till plain. However, parts of the basin include limestone plain, clay plain, sand plain and till moraine.

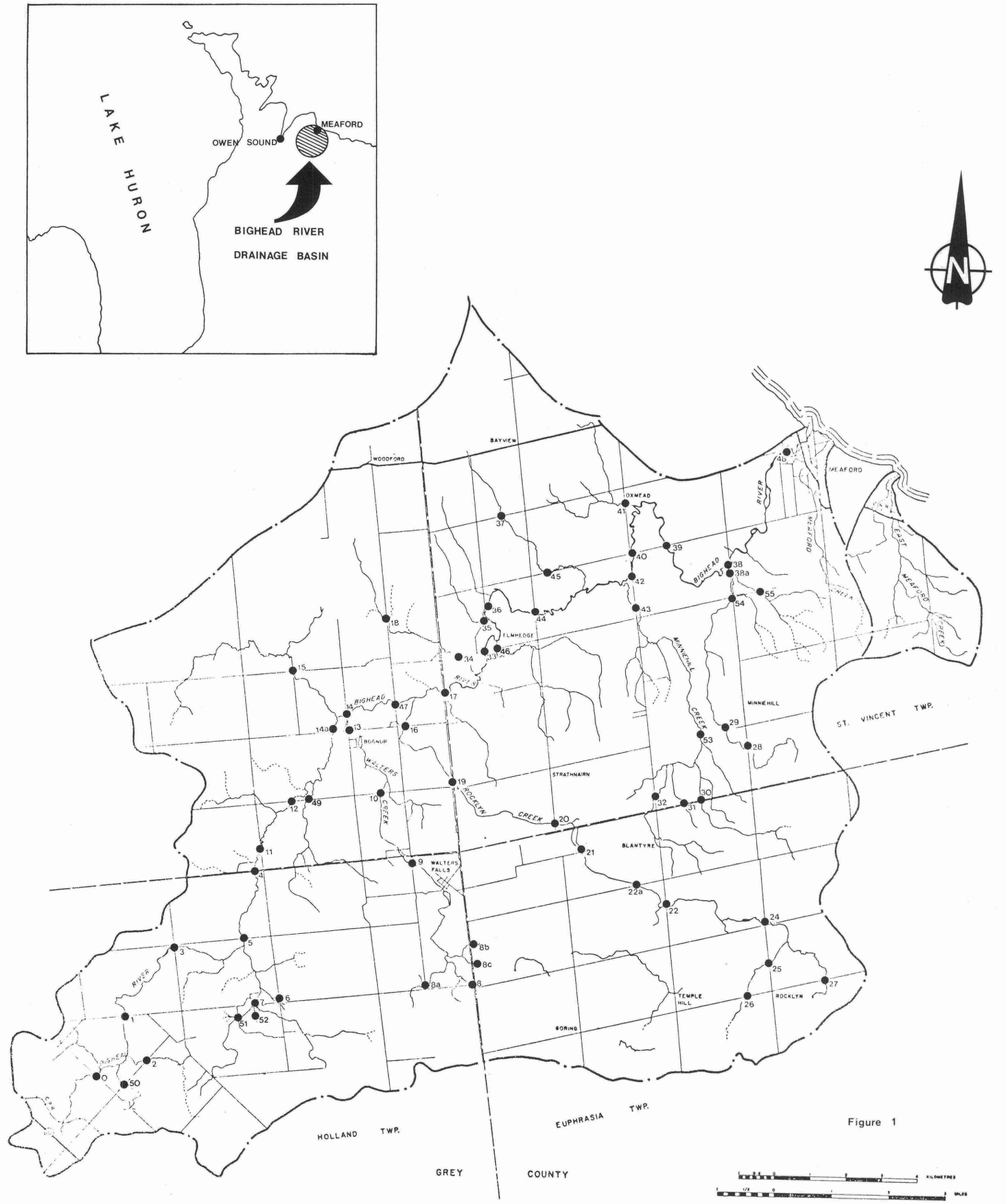

Figure 1

MINISTRY OF THE ENVIRONMENT

SAMPLING SITES ON THE

BIGHEAD RIVER

May – November 1980

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The watershed gradient averages 3.8 metres per km. Much of the steep gradient, however, is localized on the upper parts of the watershed as a result of the Niagara Escarpment. The lower part of the Bighead River proper meanders throughout relatively flat terrain.

Fishing is the main recreational use of the Bighead. Various sections of the Bighead provide excellent habitat for resident brook and brown trout, as well as for a number of migratory species (rainbow trout and salmon).

A number of ponds (about 17) are present on the watershed. A number of small ponds provide agricultural and recreational uses for their owners. A larger impoundment at Walters Falls is used to generate power for a feed mill and a sawmill. Some impoundments are also being used for private fish hatcheries, while others such as the Bognor Marsh are used for waterfowl production.

3.0 METHODS

3.1 Hydrology

Streamflow data near the mouth of the Bighead, as recorded by Federal Streamflow Gauge, was reviewed for 1980. Also, during the May to October 1980 period, streamflow was measured at 30 locations on the watershed. Numbers of measurements at any one of these locations, during the summer period, varied from 1 to 6. Efforts were made to get comparative flows throughout the watershed during periods of low summer flow.

3.2 Water Temperatures

During a warm water low-flow period in August, maximum-minimum thermometers were placed in the stream at 29 sites. Each thermometer was left in a particular measuring site for at least 72 hours. As weather conditions during the 72 hour period were generally warm and sunny, it is believed that the survey result reflected the temperatures that were near maximum for the summer.

3.3 Chemical and Bacterial Data

Water samples for chemical and bacteriological analyses were collected at a total of 41 locations in the watershed between May and November, 1980. At 29 of these sites samples were collected on at least five dates for chemical analyses and at least four dates for bacterial analyses. In addition, water quality data from long-term monitoring station (02FB010), near the mouth of the Bighead was reviewed.

3.4 Storm Event

There was a major rainfall in the Bighead watershed on the morning of July 15, 1980. A total of 58.2 mm of rain was recorded at the Meaford weather office. In order to evaluate water quality during flood conditions, a total of 19 locations were sampled, for a variety of chemical parameters.

3.5 Bottom Fauna

Collections of bottom fauna (aquatic insects and other animal life) were made at 41 stations during August. Quantitative sampling using a Surber sampler, plus two qualitative samples with a hand sieve were carried out at most stations.

3.6 Aquatic Vegetation

During June and August, observations were made as to the aquatic plant growth in the Bighead River.

4.0 DISCUSSION OF RESULTS

4.1 Hydrology

Table 1 illustrates the hydrology, during 1980, for gauging site 02FB010, located near the mouth of the Bighead River. The data reveal good base flow conditions. Typical low summer flows at the gauging station are 1-2 cms (cubic metres per second). The lowest instantaneous flow over the period of record is 0.130 cms. Appendix 1 tabulates the flow data obtained during the survey. During the low flow period of August 25-27, upstream flow measurements were made at a total of 30 locations on the watershed. Figure 2 illustrates flows throughout the watershed during that period. The figure clearly illustrates excellent base flow conditions in the Rocklyn Creek, Walters Creek, the upper reaches of the main Bighead, and the tributary draining the Bognor Marsh. In contrast, Minniehill Creek as well as the tributaries entering the lower Bighead from the north, had much lower base flows per unit area of watershed size. Once the Bighead passes the Sydenham Township-St. Vincent Township line, little increase in base flow is realized. This is despite the fact that the river still has almost half of the watershed to flow through.

The hydrology information reveals the extreme importance of the large groundwater discharges to the upper Bighead watershed. If the groundwater and surface water regime in the area was interfered with, the hydrological biological characteristics for the entire river could be greatly depreciated. Potential future interference could come from such

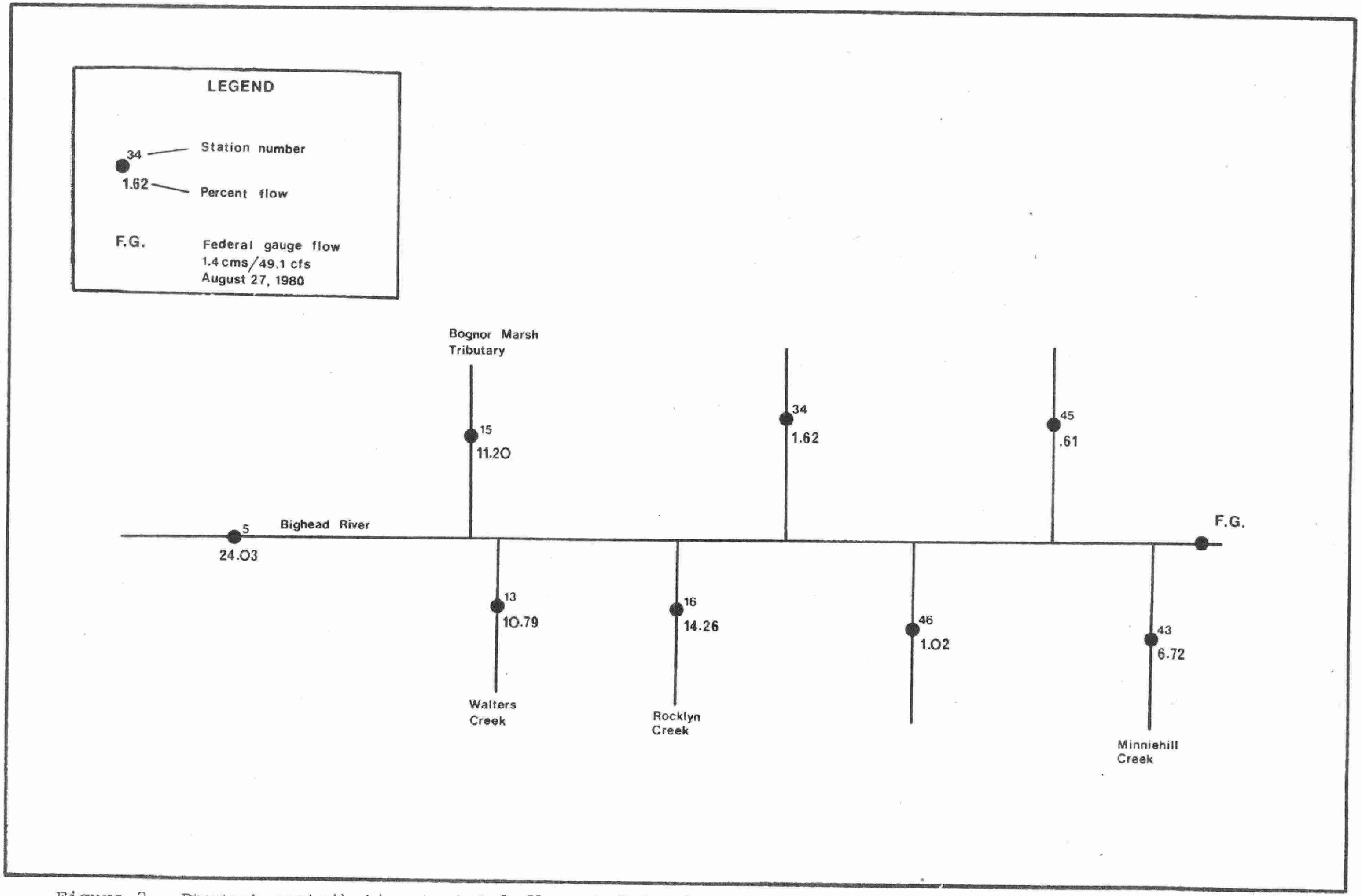

Figure 2. Percent contribution to total flow at federal gauge 02FB010 from 8 selected sites on the Bighead River, August 25-27, 1980.

TABLE 1

BIGHEAD RIVER NEAR MEAFORD
DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1980

FEDERAL STATION NO 02FB010 DRAINAGE AREA 293 KM^2

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	6.15	3.20B	1.80B	12.4	6.11	3.27	2.19	3.97	2.81	2.33	3.43	4.09
2	5.75	3.10B	1.78B	12.2	5.30	3.64	2.08	3.52	3.60	4.39	3.31	4.88
3	4.60	3.00B	1.75B	12.0	4.84	3.31	1.85	3.45	4.30	7.66	3.26	6.44
4	4.55B	2.90B	1.66B	14.3	4.42	2.81	1.63	3.05	2.83	13.2	3.78	8.05
5	4.59B	2.75B	1.60B	13.9 E	4.18	2.49	1.49	3.25	2.23	7.41	4.60	6.36
6	4.28	2.71B	1.58B	12.5 E	3.90	2.61	1.31	3.75	1.90	5.47	4.12	5.36
7	4.09	2.70B	1.56B	11.5 E	4.23	3.54	1.36	7.19	1.53	4.50	6.14	6.53
8	4.07	2.65B	1.54B	10.3 E	4.09	3.23	1.59	9.52	1.61	3.89	7.87	26.6
9	4.41	2.60B	1.52B	10.4 E	3.84	2.76	1.46	5.14	1.53	3.45	7.01	30.3
10	4.52	2.55B	1.50B	11.8 E	3.62	2.49	1.34	3.83	1.49	3.10	6.25	14.4
11	17.6	2.50B	1.49B	11.5 E	3.48	2.26	1.31	3.40	1.50	3.20	4.78	11.0
12	24.1	2.45B	1.48B	11.0 E	3.46	2.05	1.21	3.06	1.33	5.14	4.34	10.2 B
13	16.7	2.40B	1.47B	10.5 E	3.32	1.84	1.01	2.95	1.37	4.62	4.11	9.40B
14	16.6	2.35B	1.46B	15.0 E	3.49	1.71	1.04	2.72	1.75	3.87	5.95	8.60B
15	13.3	2.32B	1.45B	28.8	3.27	1.68	8.17	2.50	1.70	3.44	4.93	8.10B
16	11.1	2.30B	1.40B	17.2	3.07	1.81	7.13	2.30	1.50	3.10	4.20	7.40B
17	11.3	2.25B	7.30B	12.7	2.82	1.63	10.5	2.11	4.20	3.02	3.83	7.00B
18	14.6	2.22B	23.0 B	10.6	6.92	1.51	5.08	2.25	4.95	3.31	3.57	6.50B
19	9.17	2.20B	20.0 B	8.92	8.28	2.06	3.28	2.27	3.12	3.22	3.38	6.10B
20	6.88	2.15B	26.0 B	8.25	6.03	12.0	12.1	2.11	2.44	4.33	3.36	5.85B
21	5.80B	2.12B	45.1 B	7.49	4.81	10.0	64.9	2.18	2.23	4.34	3.63	5.55B
22	5.20B	2.10B	26.0 B	6.76	4.04	5.67	24.3	2.05	2.44	4.09	4.16	5.25B
23	4.60B	2.08B	21.0	5.91	3.48	3.97	11.0	1.85	5.70	3.60	3.76	5.00B
24	4.40B	2.03B	15.2	5.57	3.07	3.02	6.78	1.57	3.62	3.18	4.02	4.80B
25	4.10B	2.00B	12.1	5.43	2.80	2.53	5.09	1.57	3.20	3.28	4.39	4.60B
26	3.95B	1.98B	10.1	5.08	2.73	2.19	4.70	1.43	5.22	7.16	3.73	4.40B
27	3.80B	1.90B	11.6	5.08	2.53	1.99	5.27	1.40	4.11	7.05	3.47	4.20B
28	3.65B	1.85B	14.5	5.58	2.37	1.97	8.16	1.47	3.29	4.79	3.48	4.05B
29	3.55B	1.82B	15.0	7.96	2.31	1.82	9.45	1.46	2.92	4.08	3.98	3.90B
30	3.40B		15.6	7.06	3.59	2.27	5.98	1.38	2.54	3.81	3.77	3.75B
31	3.25B		14.5		3.72		4.64	1.60		3.56		3.60B
Mean	7.55	2.39	9.74	10.6	4.00	3.14	7.01	2.91	2.77	4.57	4.35	7.81
Max	24.1	3.20	45.1	28.8	8.28	12.0	64.9	9.52	5.70	13.2	7.87	30.3
Min	3.25	1.82	1.40	5.08	2.31	1.51	1.01	1.38	1.33	2.33	3.26	3.60

B - Ice Conditions E - Estimated

activities as agricultural drainage systems, the drainage of wetland areas, groundwater withdrawals for use in hatcheries or other industries, or dewatering to facilitate extractive industries. It is very important that the hydrological regime that is part of the upper watershed indicated in Figure 2 be maintained.

4.2 Water Temperatures

Figure 3 illustrates the average temperatures found during two 72 hour temperature studies (August 18-28). In general, Rocklyn Creek, Walters Creek, plus the headwater areas of the main Bighead, are cold water streams with some cool areas.

The lower part of the watershed, which has fewer springs, less streambank cover and greater agricultural development, has warmer water.

It is of interest to note that the section of Rocklyn Creek which was recently ditched, apparently to facilitate drainage, is now a warm water stream as a result of ditching.

Comparisons between the 1980 work and the work done in 1957 by the North Grey Conservation Authority (1959 North Grey Conservation Authority Report), reveal that certain sections of the watershed have changed from cold streams to warm streams. These include the Bognor Marsh tributary, Minniehill Creek, Dunedin Creek, and the channelized section of Rocklyn Creek.

Whether or not the Bighead remains a prime fishery stream will depend on the maintenance of cold water in the Rocklyn Creek, Walters Creek and the main Bighead River upstream from Bognor. Maintenance of the these cold water

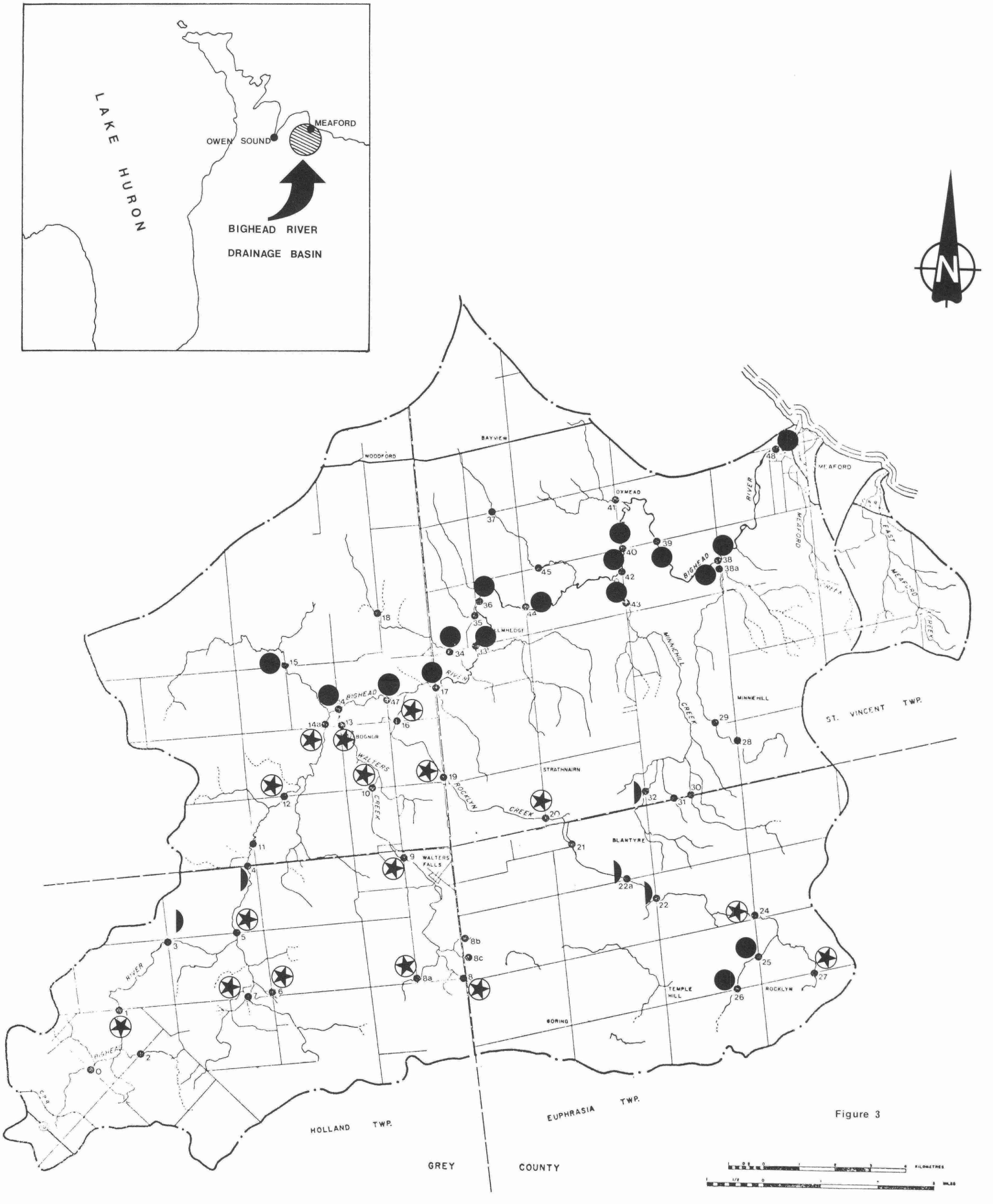

Figure 3

★ FLOW COLD 20°C & less

◗ FLOW COOL >20° - 23°C

● FLOW WARM >23°C

MINISTRY OF THE ENVIRONMENT

WATER TEMPERATURE RANGES
AT SELECTED STATIONS
ON BIGHEAD RIVER
August 18-28, 1980

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areas will depend on the retention of stream side vegetation which provides shade and/or maintenance of sensitive groundwater and discharge areas which continually cool the stream.

4.3 Suspended Solids

Water clarity is normally excellent and thus very few suspended solids analyses were carried out. However, at most of the watershed sampling locations, at least one measurement was made during turbid water conditions. At only three of the sampling locations a concentration of greater than 500 mg/l was found. Two of these were on the main river near the mouth, stations 42 and 48, and one near the mouth of Minniehill Creek (station 43). A routine visual observation of the watershed confirmed that Minniehill Creek, because of agricultural activities, is considerably affected by erosion and turbidity.

4.4 Phosphorus

In general, levels of phosphorus on the Bighead were very low. It would appear that the background level of phosphorus in the watershed (i.e. without man's land use disturbances) would be less than 0.010 mg/l. This background concentration is less than 1/3 of this Ministry's objective of 0.030 mg/l.

Figure 4 illustrates that at those 29 locations where five or more samples were collected; the Ministry's objective was exceeded at only five locations. At 5 of the 29 locations, the average concentration was less than 10 micrograms/l. At 17 locations the average concentration was between 10 and 20 micrograms/l. Two of the five locations which exceeded 30 micrograms/l were located on Rocklyn Drain; the recent channelization of the drain has resulted in substantial elevation of phosphorus. A third location

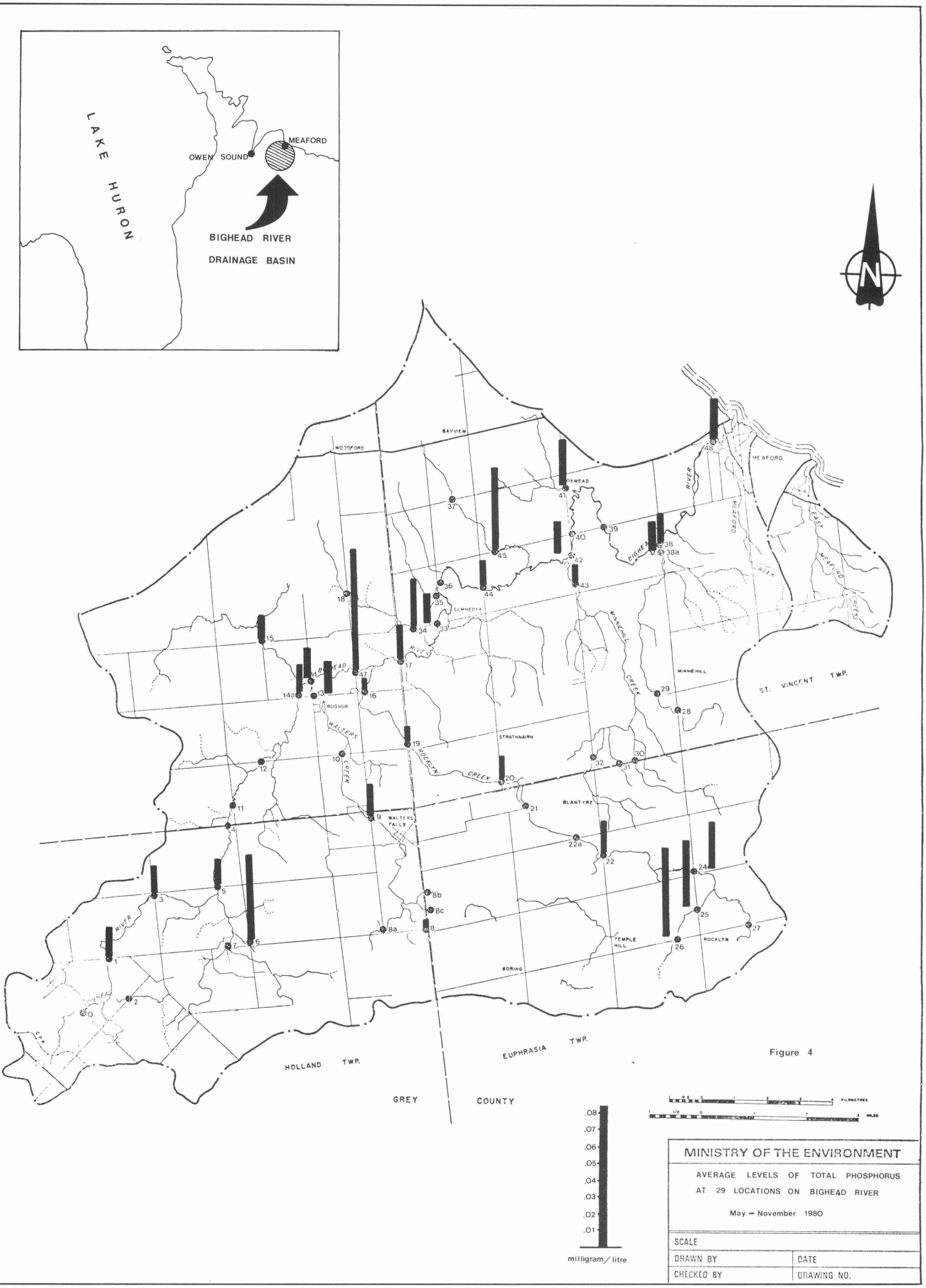

Figure 4

MINISTRY OF THE ENVIRONMENT

AVERAGE LEVELS OF TOTAL PHOSPHORUS
AT 29 LOCATIONS ON BIGHEAD RIVER

May – November 1980

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with phosphorus above 30 micrograms/l was located in the upper reaches of the Bighead (station 6) downstream from a fish hatchery. The fourth location (station 45) was located on a small tributary entering the lower Bighead from the north. The reason for this being elevated is not known. The fifth location (station 47) was located on the main stream of the Bighead River near an intensive livestock production area.

4.5 Nitrogen

Levels of nitrogen are in general, favorably low in the watershed. The Kjeldahl, nitrite and ammonia fractions are uniformly low throughout the whole watershed. The raw data is tabulated in Appendix III.

Nitrate levels are illustrated in Figure 5. While most areas of the watershed had average nitrate levels below 1 mg/l, a few stations had average values in the 2 to 3 mg/l range. These elevated values in some headwater areas no doubt reflect discharges from surficial aquifers, which have been impacted somewhat from land use activities (e.g. fertilizers, feedlot, subsurface disposal systems). The elevated concentrations reveal the sensitivity of the surficial aquifer to contamination, at least in some areas of the watershed.

4.6 Other Chemical Parameters

No attempt is made in this report to interpret the remaining chemical parameters which are less significant in evaluating the health of the river. However, the data are outlined in the appendix for future reference and comparative purposes.

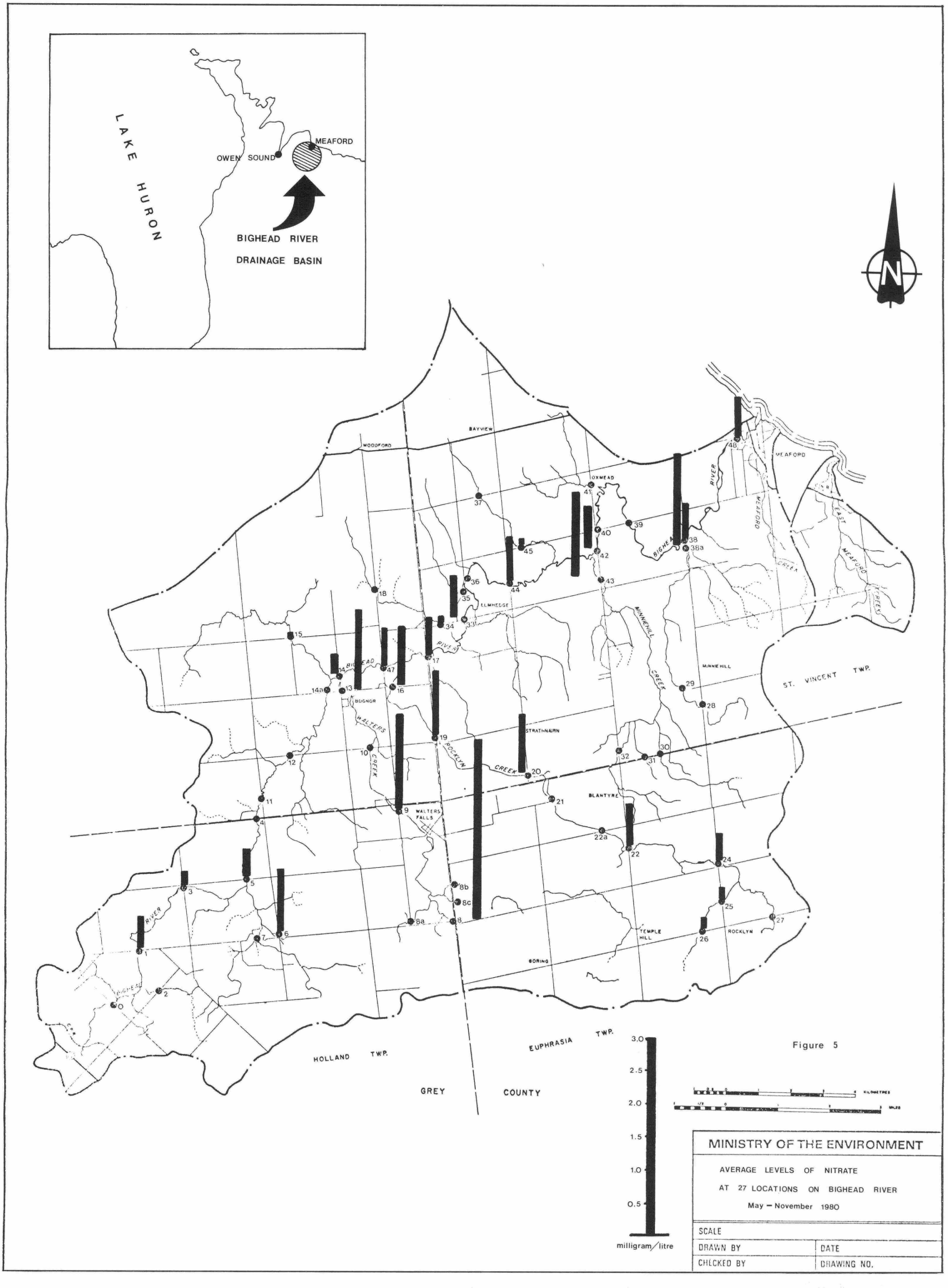

Figure 5

MINISTRY OF THE ENVIRONMENT

AVERAGE LEVELS OF NITRATE

AT 27 LOCATIONS ON BIGHEAD RIVER

May – November 1980

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4.7 Storm Conditions

On July 15, nineteen locations were sampled (see Appendix III), during the latter part of a major rainstorm when the river was in flood. A large majority of these samples revealed greatly reduced water quality. Levels of phosphorus and suspended solids, for example, were typically one or two orders of magnitude higher than those under normal summer flow conditions. The location with the highest quality during the storm was station #15, located on the tributary draining the Bognor Marsh. Unlike the other sampling locations, stream quality downstream from the Bognor Marsh changed little from low flow quality. This sample indicates the quality benefit of wetland maintenance on the Bighead River. The wet weather data revealed that soil conservation measures are needed on the Bighead watershed, even with the present level of land use activities.

4.8 Bacteria

Figure 6 illustrates levels of total coliforms, fecal coliforms, fecal streptococci and Pseudomonas aeruginosa. Bacterial levels at many of the sampling sites exceeded the swimming criteria of the Ministry, which are presented on Figure 6. In general, bacteria levels are high considering the overall high chemical quality of waters in the watershed. The elevated levels however, are no doubt a reflection of the livestock populations in the watershed. At numerous locations, cattle and other livestock have direct access to the streams. Also, many farmyard areas are directly adjacent to the streams, thus allowing direct manure access to the water courses.

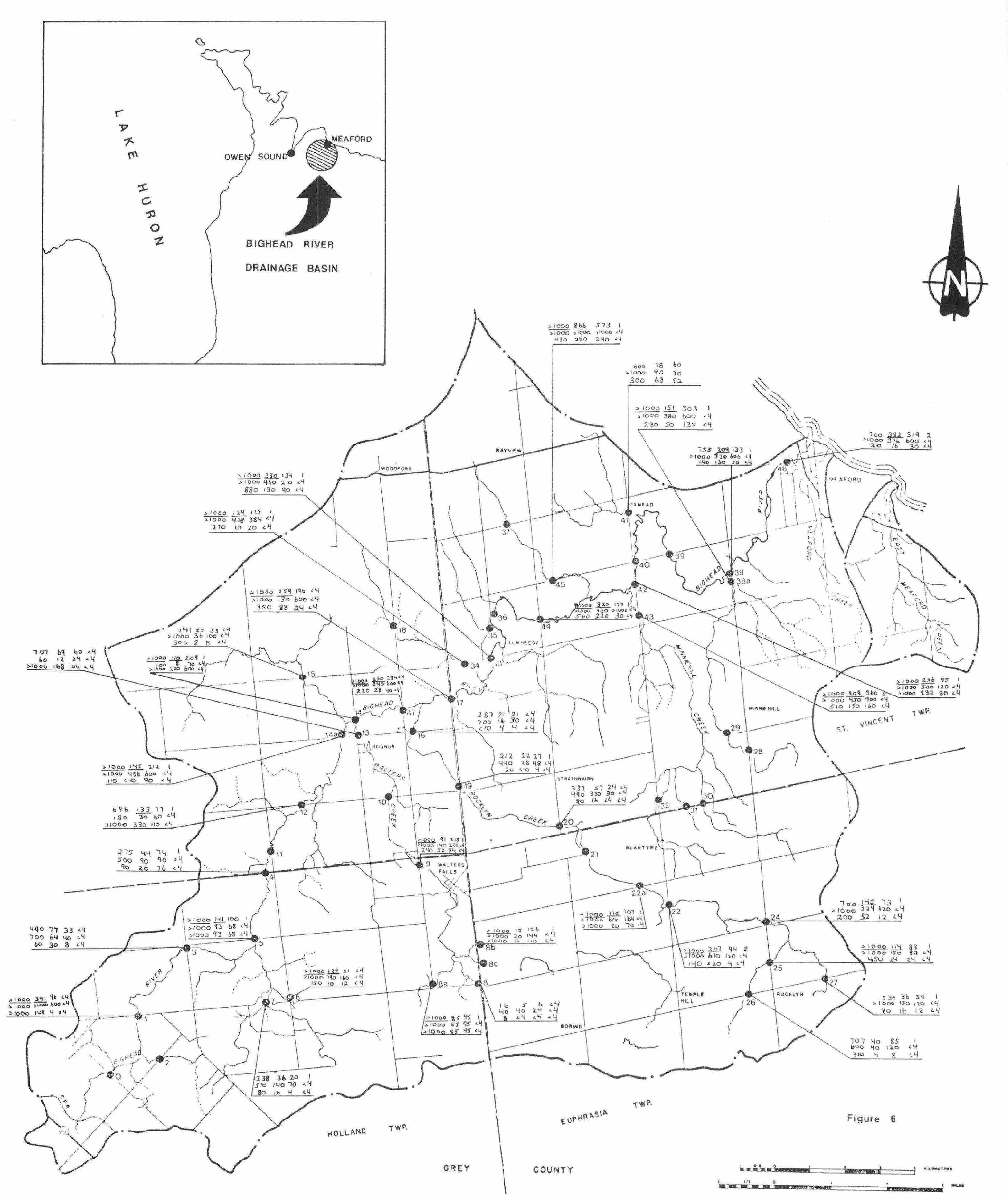

Figure 6

MINISTRY OF THE ENVIRONMENT GUIDELINES

Swimming and Bathing Use of Water

TC – TOTAL COLIFORM should not exceed 1000 per 100 ml
FC – FECAL COLIFORM should not exceed 100 per 100 ml
FS – FECAL STREPTOCOCCI
PSa – PSEUDOMONAS aeruginosa
> no guidelines, should not be present

Example:

BACTERIA/100ml

	TC	FC	FS	PSa
G.MEAN	707	40	85	1
MAX.	600	40	120	<4
MIN.	310	4	8	<4

——— geometric mean above guidelines

MINISTRY OF THE ENVIRONMENT

BACTERIOLOGICAL CONCENTRATIONS
AT 36 LOCATIONS ON BIGHEAD RIVER
May – November 1980

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4.9 Bottom Fauna

The bottom fauna data are presented in Appendix II.

In general, the Bighead watershed supports an excellent benthic community. The species diversity, community balance, and the biomass per unit area suggest an excellent food base for game fish. There is a very large variety of insects, including stoneflies, mayflies and caddisflies which serve as excellent fish food. The large variety of invertebrates is a good indication of high water quality and ecological stability. At many of the sampling locations, twenty to thirty different types of invertebrates were found. The greatest variety of life (35 taxa) was found at station 20 on Rocklyn Creek.

5.0 AQUATIC VEGETATION

Growths of pondweed (Potamogeton spp.) were common in the even-flow sections of the Bighead downstream from Bognor. The growths were not excessive, however. Growths of the filamentous green algae Cladophora were not common in the Bighead River. However, significant growths were observed at stations 36 and 48, as well as both sampling locations on the newly channelized section of Rocklyn Creek (Stations 25 and 26).

Cladophora is a nuisance aquatic plant which grows profusely in nutrient-rich streams and lakes. Nutrient levels in the Bighead are too low to support widespread growth of this plant. As significant growths were found in the aforementioned sections of the watershed, however, it is apparent that future nutrient levels must be kept at or near the present concentrations. The growth of this troublesome algae in the future will also depend on the extent to which the streams continue to be shaded by bank vegetation.

6.0 GROUNDWATER

The Bighead River basin is divided into two major physiographic units. The first unit is a limestone plain consisting of middle silurian dolomite overlain by a thin veneer of overburden and in some cases would be considered sensitive to contamination from surface activities due to its shallow nature. These conditions exist on the east and on the west sides of the basin where the system is bounded by rock cliffs. The second area is predominantly a drumlin till plain with thick (30 m+) glacial and lacustrine deposits of ordovician and silurian shale carbonates. These conditions exist within the valley where the sides and floor are completely covered with drumlins.

The two hydrogeological zones (shallow water aquifer and deep water aquifer) are very important to the water quality of the Bighead River. On the limestone plain, most wells are completed to shallow depths within the dolomite bedrock. On the lower till plain area, wells tap numerous sand and gravel aquifers in the overburden which are protected from surface contaminants by overlying deposits of silt and clay.

A brief review of water well records for the basin shows no discernible change in water quality in the thirty years of records. The records do not list shallow wells, the most susceptible to problems. No major groundwater problems are known to exist within the basin.

The modification of the watershed headwaters by projects such as Rocklyn Creek drainage work, and the proposed large scale gravel extraction, is likely to have negative impacts on both surface and groundwater. Large drainage projects lower water levels in the shallow water aquifers (wetland areas), shorten the duration and increase the height of flood peaks, and significantly reduce base flow to streams from the areas drained. The removal of large deposits of aggregates from the watershed has similar effects, but also reduces the amount of natural treatment of groundwater provided by these media.

APPENDIX I

BIGHEAD RIVER NEAR MEAFORD

1957-80 Period of Record   293 Sq. Km. Drainage Area

	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC
Average Mean Monthly Flow	4.35	4.40	9.99	12.6	4.76	2.07	1.54	1.11	1.23	2.00	3.95	5.40
Average Minimum Mean Monthly Flow with a Recurrance Interval of 2 Years	4.18	3.8	8.8	12.5	4.70	1.82	0.96	0.90	0.98	1.4	3.4	4.9
Average Minimum Mean Monthly Flow with a Recurrance Interval of 5 Years	2.29	2.55	5.7	7.3	3.10	1.19	0.79	0.60	0.56	0.72	1.68	2.7
Average Minimum Mean Monthly Flow with a Recurrance Interval of 10 Years	1.82	2.15	3.8	6.6	2.06	0.95	0.62	0.50	0.46	0.59	1.05	1.95
Average Minimum Mean Monthly Flow with a Recurrance Interval of 20 Years	1.62	1.8	2.2	5.0	1.85	0.83	0.45	0.44	0.40	0.52	0.68	1.56

NOTE: All flows in cms

Bighead River Flow Data May-October 1980
Summary of 30 selected streamflow sites

Station	Date	cms	cfs	Remarks
Sta 0	Aug 12	--	--	Bighead tributary unable to gauge (low flow)
Sta 1	May 20	.541	19.1	Bighead River
	June 16	.184	6.5	
	Aug 11	.159	5.6	
	Aug 12	.159	5.6	
	Aug 27	.127	4.5	
	Oct 1	.159	5.6	
Sta 5	Aug 12	.515	18.2	Bighead River
	Aug 27	.334	11.8	
Sta 6	Aug 12	.085	3.0	Bighead tributary
	Aug 25	.051	1.8	
Sta 7	Aug 12	.133	4.7	Bighead tributary (flow combination of Sta 52 + 7)
	Aug 25	.136	4.8	
Sta 9	Aug 12	.677	23.9	Walters Creek
	Aug 25	.886	31.3	
Sta 13	May 20	1.441	50.9	Walters Creek
	June 16	.773	27.3	
	Aug 11	.946	33.4	
	Aug 25	.150	5.3	
	Oct 1	.623	22.2	
Sta 14	May 20	2.084	73.6	Bighead River near Bognor
	June 16	.603	21.3	
	Aug 11	1.158	40.9	
	Aug 25	.586	20.7	
	Oct 1	.606	21.4	
Sta 15	May 20	.742	26.2	Bognor Marsh branch of Bighead River
	June 16	.079	2.8	
	July 15	.232	8.2	
	Aug 11	.527	18.6	"downstream from" dam
	Aug 25	.156	5.5	
	Oct 1	.076	2.7	
Sta 16	May 20	.532	18.8	Rocklyn Creek
	June 17	.229	8.1	
	July 14	.156	5.5	
	Aug 11	.300	10.6	
	Aug 25	.198	7.0	
	Oct 1	.209	7.4	

Station	Date	cms	cfs	Remarks
Sta 19	Aug 12	.317	11.2	Rocklyn Creek
	Aug 25	.195	6.9	
Sta 20	Aug 12	.289	10.2	Rocklyn Creek
	Aug 25	.147	5.2	(at north bridge)
Sta 20	Aug 12	.057	2.0	Rocklyn Creek
	Aug 25	.037	1.3	(at south bridge)
Sta 24	Aug 12	.167	5.9	Rocklyn Creek
	Aug 25	.091	3.2	
Sta 25	Aug 12	.037	1.3	Rocklyn Creek
Sta 26	Aug 12	.025	0.9	Rocklyn Creek
Sta 27	Aug 12	--	--	Rocklyn Creek unable to gauge (wet land area)
Sta 32	Aug 25	.051	1.8	Minniehill Creek
Sta 34	July 14	--	--	Bighead tributary
	Aug 11	.244	8.6	Unable to gauge
	Aug 27	.167	0.8	July 14 (low flow)
	Oct 1	.167	5.9	
Sta 38a	May 21	.113	4.0	Dunedin Creek
	June 17	--	--	Unable to gauge
	July 14	--	--	(low flow)
	Aug 14	.045	0.5	
	Aug 25	.014	0.5	
	Oct 1	.020	0.7	
Sta 41	Aug 12	.006	.2	Bighead tributary
	Aug 25	--	--	Unable to gauge (low flow)
Sta 42	Aug 12	2.577	91.0	Bighead River
	Aug 25	1.390	49.1	Federal Gauge Site 02FB010
Sta 43	May 21	.218	7.7	Minniehill Creek
	June 17	.105	3.7	
	July 14	.065	2.3	
	Aug 11	.229	8.1	
	Aug 25	.093	3.3	
	Oct 1	.105	3.7	
Sta 45	May 21	.127	4.5	Bighead tributary
	June 17	.008	0.3	
	July 14	--	--	Unable to gauge (low flow)
	Aug 11	.079	2.8	
	Aug 27	.008	0.3	
	Oct 1	.008	0.3	

Station	Date	cms	cfs	Remarks
Sta 46	Aug 13	--	--	Bighead tributary
	Aug 27	--	--	unable to gauge (low flow)
Sta 49	Aug 13	.059	2.1	Bighead tributary
Sta 50	Aug 12	--	--	Bighead tributary unable to gauge (low flow)
Sta 52	Aug 12	.054	1.9	Bighead tributary
Sta 53	Aug 14	.133	4.0	Minniehill Creek
	Aug 25	.074	2.6	
Sta 54	Aug 14	.051	1.8	Dunedin Creek
	Aug 25	.020	.7	
Sta 55	Aug 14	--	--	Dunedin Creek
	Aug 25	--	--	unable to gauge (low flow)

Bighead River Flow Data May-October 1980 Summary of nine main sites and their percent contribution to total flow in the Bighead River

Station Number	Date of Run	Discharge		Percent contribution to total flow (total flow measured at Federal Gauge No. 02FB010)
		cms	cfs	
Sta 5	Aug 11-14	.515	18.2	20.00
	Aug 25-27	.334	11.8	24.03
Sta 15	May 20-21	.742	26.2	13.53
	June 16-17	.079	2.8	2.66
	July 14	.232	8.2	22.10
	Aug 11-14	.527	18.6	20.44
	Aug 25-27	.156	5.5	11.20
	Oct 1	.076	2.7	3.26
Sta 13	May 20-21	1.441	50.9	26.29
	June 16-17	.773	27.3	25.96
	Aug 11-14	.946	33.4	36.70
	Aug 25-27	.150	5.3	10.79
	Oct 1	.629	22.2	26.68
Sta 16	May 20-21	.532	18.8	9.71
	June 16-17	.229	8.1	7.70
	July 14	.156	5.5	14.82
	Aug 11-14	.300	10.6	11.65
	Aug 25-27	.198	7.0	14.26
	Oct 1	.210	7.4	8.89
Sta 34	July 14	.014	0.5	1.35
	Aug 11-14	.244	8.6	9.45
	Aug 25-27	.023	0.8	1.62
	Oct 1	.167	5.9	7.09
Sta 46	Aug 11-14	.034	1.2	1.32
	Aug 25-27	.014	0.5	1.02
Sta 45	May 20-21	.127	4.5	2.32
	June 16-17	.008	0.3	0.29
	July 14	.004	0.15	0.40
	Aug 11-14	.079	2.8	3.08
	Aug 25-27	.008	0.3	0.61
	Oct 1	.008	0.3	0.36
Sta 43	May 20-21	.218	7.7	3.98
	June 16-17	.105	3.7	3.52
	July 14	.065	2.3	6.20
	Aug 11-14	.229	8.1	8.90
	Aug 25-27	.093	3.3	6.72
	Oct 1	.105	3.7	4.45
Sta 49	Aug 11-14	.059	2.1	2.31

APPENDIX II

APPENDIX II: MACROINVERTEBRATES COLLECTED AT 41 SAMPLE SITES ON THE BIGHEAD RIVER AND TRIBUTARIES, AUGUST 1980 (NUMBER PER FT. SQ.)

	BIGHEAD RIVER																		
ORGANISM	7	6	0	1	3	5	4	12	14A	15	14	47	17	33	36	42	39	38	48
MEGALOPTERA (DOBSONFLIES, FISHFLIES, ALDERFLIES)																			
Corydalidae																			
Corydalus cornutus					2	1	3		3		2				1	P			
Chauliodes							1		1										
Sialidae																			
Sialis											1		P			1			
PLECOPTERA (STONEFLIES)																			
Perlidae																			
Acroneuria						P						1							
Neophasganophora						3	1	1			4		1		1	1			3
Paranetina	1							P	1	2	1		P	2	1	P			2
Perlesta					5		P		P										
Neoperla											1								
Taeniopterygidae																			
Taenionema	5																		
Leuctridae							P												
Nemouridae					1														
Perlodidae																			
Isoperla																			
EPHEMEROPTERA (MAYFLIES)																			
Ephemeridae																			
Ephemera simulans																			
Caenidae																			
Tricorythodes				2			1	P	10		1	1	1	2		1			1
Caenis					1		1	1			P								1
Ephemerallidae																			
Ephemerella	1					1					1								
Leptophlebiidae																			
Leptrophlebia												1							
Paraleptophlebia	4				1														

APPENDIX II: (continued)

BIGHEAD RIVER

Organism	7	6	0	1	3	5	4	12	14A	15	14	47	17	33	36	42	39	38	48
Baetidae																			
Isonychia					P	P	P		P	1	1		1	1	P	P			1
Baetis	8	P		1	40	10	8	13	4	1	15	3	2	19	19	24			86
Heptageniidae																			
Stenonema					1	P	1	1			2		P	1	1				11
S. tripunctatum				4						1		1							
S. fuscum				2		P													
S. nepotellum						1		1	1		2	4	1	4	1	2			3
S. rubrum										1									
Stenacron						P			P	1	P	1	1	2	P	1			
Unidentified						1													
TRICHOPTERA (CADDISFLIES)																			
Helicopsychidae																			
Helicopsyche					1	1													
Hydropsychidae																			
Hydropsyche	2			8	120	3	3	38	80	7	57	1	48	111	110	60			102
Parapsyche		P																	
Cheumatopsyche	1			9	3	1	1	14	20	14	43		25	50	43	32			31
Hydroptilidae																			
Hydroptila					16										1	1			6
Agraylea																			2
Mayatrichia																			2
Leptoceridae																			
Oecetis																			
Nectopsyche																			
Glossosomatidae																			
Glossosoma						2	1	1							1				
Rhyacophilidae																			
Rhyacophila	1	P				8		5			1								

APPENDIX II: (continued)

BIGHEAD RIVER

Organism	7	6	0	1	3	5	4	12	14A	15	14	47	17	33	36	42	39	38	48
Philoptamidae																			
Chimarra				1	13	1					1			1	1	1			2
Dolophilodes															P				
Polycentropodidae																			
Polycentropus												1	P	1					P
Psychomyiidae																			
Psychomyia					1								16	4	11				
Lepidostomatidae																			
Lepidostoma	12					P													
Limnephilidae																			
Neophylax				1									P						
Hydatophylax												3	1			P			
Pycnopsyche				1															
Hesperophylax		P																	
Limnephilus																			
Psychoglypha																			
Pupae (unidentified)	5	P		18	14		2	1	2	3			P	P	1				2
ODONATA																			
ZYGOPTERA (DAMSELFLIES)																			
Agrionidae				4	P	P	P	P	P		P	2	P			P	P		
Coenagrioridae			P						P	1		3		P	1	P			
ANISOPTERA (DRAGONFLIES)																			
Aeshnidae			P	2	P		P									P			
Libellulidae			P			P				1									
Cordulegastridae	2															1			
Gomphidae	1																		
COLEOPTERA (BEETLES)																			
Dytiscidae																			

APPENDIX II: (continued)

BIGHEAD RIVER

Organism	7	6	0	1	3	5	4	12	14A	15	14	47	17	33	36	42	39	38	48
Elmidae	1			1	36	14	11	53	144		301	1	36	32	180	115			3
Psephenidae				1	3	1		1	1	4			P	1					P
Haliplidae					1														
Hydrophilidae						P													
Adults (unidentified)	5		P	3	4	3	20	17	8		18	4	5	45	17	39	P		15
HEMIPTERA (TRUE BUGS)																			
Corixidae			P	2			P		P			3		P					
Gerridae				1	P				P			1							P
Notonectidae																			
Belostomatidae																			
HYDRACARINA (MITES)	1	P			3	4	1	1	4		2		4	5	5	4			3
AMPHIPODS (SCUDS)																			
Taltridae																			
Hyalella azteca			P	3						6		5		P			P		
Gammaridae																			
Gammarus																			
ISOPODS (SOW BUGS)																			
Asellidae		P		1	P	P				3					P				P
DECAPODA (CRAYFISHES)																			
Astacidae																			
Cambarus robustus				1	1	1	P	P											
Orconectes propinquus					P	P		P		5				P					
Orconectes virilis							P					2		1					
Orconectes immature						P			P		P		P	P					
Cambarus immature																			

APPENDIX II: (continued)

BIGHEAD RIVER

ORGANISM	7	6	0	1	3	5	4	12	14A	15	14	47	17	33	36	42	39	38	48
PELECYPODA (CLAMS)																			
Sphaeriidae																			
Pisidium	6			1	P				1	3		1	P						
Sphaerium			P	1		P	P								P	P			
Unionidae							P	P			P			1					
GASTROPODA (SNAILS)																			
Ancylidae																			
Ferrissia													P						
Planorbidae																			
Gyraulus																			
Helisoma			P											1					
Lymnaeidae																			
Lymnaea	1			1						1									
Physidae																			
Physa	1	P	P	6	P	P	P	P	1	1	P	4	P	P	P	P	P		1
DIPTERA (TRUE FLIES)																			
Tipulidae	2							1	5										
Tipula																			1
Antocha					8	1	5	8	33		25		32	65	17	6			
Simuliidae	1	P				2	4	2							4	1			
Chironomidae	7	P		3	64	28	13	11	30	6	27	6	23	27	102	33			106
Stratiomyidae																			
Rhagionidae	1																		
Athrix					42		1		26		14		1	6	3				P
Tabanidae																			
Chrysops													P						
Anthomyiidae		P																	
Ephydridae																			
Pupae unidentified	1			1	8		4	1	10		9		4		9				21

APPENDIX II: (continued)

BIGHEAD RIVER

ORGANISM	7	6	0	1	3	5	4	12	14A	15	14	47	17	33	36	42	39	38	48
OLIGOCHAETA (WORMS)																			
Tubificidae					1							1					P		20
Enchytraeidae		P																	
HIRUDINEA (LEECHES)																			
Glossiphoniidae	1												1						
TURBELLARIA (FLATWORMS)		P			18			1	1				P	1	3	1	P		1
LEPIDOPTERA (AQUATIC CATERPILLARS)																			
Pyralidae																			
Parargyractis				1							3				4	1			
Total Ave. # of Organisms	71	12	9	80	408	86	82	172	385	61	533	50	203	383	537	325	6	0	427
Total Taxa per Station	22	12	0	25	31	30	26	23	26	18	27	21	28	26	27	27			26

Total Taxa - 81

Total Overall Taxa 95

APPENDIX II: (continued)

				ROCKLYN CREEK			
ORGANISM	27	24	22A	22	20	19	16
MEGALOPTERA (DOBSONFLIES, FISHFLIES, ALDERFLIES)							
Corydalidae							
Corydalus cornutus			1		4		2
Chauliodes							1
Sialidae							
Sialis					P		
PLECOPTERA (STONEFLIES)							
Perlidae							
Acroneuria			1		3	1	1
Neophasganophora			3	P			1
Paranetina			P	P		2	1
Perlesta							
Neoperla							
Taeniopterygidae							
Taenionema					30	2	
Leuctridae							
Nemouridae							
Perlodidae							
Isoperla					1		
EPHEMEROPTERA (MAYFLIES)							
Ephemeridae							
Ephemera simulans			2				P
Caenidae							
Tricorythodes							
Caenis						P	1
Ephemerallidae							
Ephemerella						1	
Leptophlebiidae							
Leptrophlebia					1		
Paraleptophlebia					4	1	2
Baetidae							
Isonychia			1	P		P	2
Baetis			6	P	41	121	17
Heptageniidae							
Stenonema			3	P	1	P	2
S. tripunctatum							
S. fuscum							
S. nepotellum			2	P			
S. rubrum							
Stenacron			1	P	1		
Unidentified							
TRICHOPTERA (CADDISFLIES)							
Helicopsychidae							
Helicopsyche			P	P			

APPENDIX II: (continued)

ROCKLYN CREEK

ORGANISM	27	24	22A	22	20	19	16
Hydropsychidae							
Hydropsyche			30	P	37		3
Parapsyche							
Cheumatopsyche	P	P	13	P	15	8	1
Hydroptilidae							
Hydroptila					2	15	1
Agraylea							
Mayatrichia							
Leptoceridae							
Oecetis					1		
Nectopsyche							
Glossosomatidae							
Glossosoma					1		1
Rhyacophilidae							
Rhyacophila					4	3	3
Philoptamidae							
Chimarra			2	P			
Dolophilodes					37	4	
Polycentropodidae							
Polycentropus	P		9		1		
Psychomyiidae							
Psychomyia							
Lepidostomatidae							
Lepidostoma							
Limnephilidae							
Neophylax							
Hydatophylax			2	P			
Pycnopsyche							
Hesperophylax					P		
Limnephilus	P	P				P	
Psychoglypha					2		
Pupae (unidentified)			P		7	1	2
ODONATA							
ZYGOPTERA (DAMSELFLIES)							
Agrionidae			P	P		P	P
Coenagrioridae		P					
ANISOPTERA (DRAGONFLIES)							
Aeshnidae							
Libellulidae							
Cordulegastridae							
Gomphidae							
COLEOPTERA (BEETLES)							
Dytiscidae							
Elmidae			1		112	4	2
Psephenidae			3	P	2		2

APPENDIX II: (continued)

ROCKLYN CREEK

ORGANISM	27	24	22A	22	20	19	16
Haliplidae							
Hydrophilidae							
Adults (unidentified)	P		1		22	1	
HEMIPTERA (TRUE BUGS)							
Corixidae							
Gerridae							
Notonectidae							
Belostomatidae							
HYDRACARINA (MITES)					4	1	1
AMPHIPODS (SCUDS)							
Taltridae							
Hyalella azteca	P	P	1	P	2		
Gammaridae							
Gammarus	P	P	1	P			
ISOPODS (SOW BUGS)							
Asellidae							
DECAPODA (CRAYFISHES)							
Astacidae							
Cambarus robustus						1	
Orconectes propinquus							
Orconectes virilis			1				
Orconectes immature							
Cambarus immature						P	
PELECYPODA (CLAMS)							
Sphaeriidae							
Pisidium	P		1		3	P	
Sphaerium							
Unionidae							
GASTROPODA (SNAILS)							
Ancylidae							
Ferrissia							
Planorbidae							
Gyraulus	P				1		P
Helisoma	P						
Lymnaeidae							
Lymnaea	P						
Physidae							
Physa	P		P	P	3		P

APPENDIX II: (continued)

ROCKLYN CREEK

ORGANISM	27	24	22A	22	20	19	16
DIPTERA (TRUE FLIES)							
Tipulidae							1
Tipula						P	1
Antocha			2		2	13	8
Simuliidae			1		P	1	
Chironomidae	P	P	45	P	78	66	13
Stratiomyidae							
Rhagionidae							
Athrix					1		
Tabanidae							
Chrysops							
Anthomyiidae							
Ephydridae					P	11	4
Pupae unidentified					1		
OLIGOCHAETA (WORMS)							
Tubificidae					3	P	
Enchytraeidae							
HIRUDINEA (LEECHES)							
Glossiphoniidae	P	P		P	2		
TURBELLARIA (FLATWORMS)					1		
Total Ave. # of Organisms			133		393	257	73
Total Taxa per Station	13	7	26	18	35	25	27

Total Taxa 56

APPENDIX II: (continued)

WALTERS CREEK

ORGANISM	8	8A	8B	8C	9	10	13
MEGALOPTERA (DOBSONFLIES, FISHFLIES, ALDERFLIES)							
Corydalidae							
Corydalus cornutus		P			2	1	P
Chauliodes							
Sialidae							
Sialis				P			
PLECOPTERA (STONEFLIES)							
Perlidae							
Acroneuria					P	2	
Neophasganophora					P	3	2
Paranetina					1	1	5
Perlesta							
Neoperla							
Taeniopterygidae							
Taenionema				P	4	1	2
Leuctridae							
Nemouridae	P			P			
Perlodidae							
Isoperla							
EPHEMEROPTERA (MAYFLIES)							
Ephemeridae							
Ephemera simulans							
Caenidae							
Tricorythodes							
Caenis					4	1	1
Ephemerallidae							
Ephemerella	P					5	
Leptophlebiidae							
Leptrophlebia							
Paraleptophlebia		P		P	1	3	P
Baetidae							
Isonychia							
Baetis	P			P	105	94	26
Heptageniidae							
Stenonema					2		
S. tripunctatum							
S. fuscum		P			2		
S. nepotellum							2
S. rubrum							
Stenacron							
Unidentified							
TRICHOPTERA (CADDISFLIES)							
Helicopsychidae							
Helicopsyche						1	1

APPENDIX II: (continued)

WALTERS CREEK

ORGANISM	8	8A	8B	8C	9	10	13
Hydropsychidae							
Hydropsyche		P			23	27	14
Parapsyche							
Cheumatopsyche					2	10	2
Hydroptilidae							
Hydroptila					1	3	
Agraylea							
Mayatrichia							
Leptoceridae							
Oecetis						1	
Nectopsyche							
Glossosomatidae							
Glossosoma				P	7	13	
Rhyacophilidae							
Rhyacophila					3	2	
Philoptamidae							
Chimarra					P		
Dolophilodes					6	9	3
Polycentropodidae							
Polycentropus					1		
Psychomyiidae							
Psychomyia							
Lepidostomatidae							
Lepidostoma		P		P			
Limnephilidae							
Neophylax							
Hydatophylax						P	P
Pycnopsyche							
Hesperophylax				P			
Limnephilus		P					
Psychoglypha				P			
Pupae (unidentified)	P	P		P	27		
ODONATA							
ZYGOPTERA (DAMSELFLIES)							
Agrionidae		P					
Coenagrioridae							
ANISOPTERA (DRAGONFLIES)							
Aeshnidae							
Libellulidae						2	
Cordulegastridae		P					
Gomphidae		P					
COLEOPTERA (BEETLES)							
Dytiscidae				P			
Elmidae		P			6	11	6
Psephenidae					8	1	

APPENDIX II:

WALTERS CREEK

ORGANISM	8	8A	8B	8C	9	10	13
Haliplidae			P			1	
Hydrophilidae							
Adults (unidentified)			P		1	1	1
HEMIPTERA (TRUE BUGS)							
Corixidae		P					
Gerridae		P	P				
Notonectidae							
Belostomatidae							
HYDRACARINA (MITES)					6		2
AMPHIPODS (SCUDS)							
Taltridae							
Hyalella azteca		P					
Gammaridae							
Gammarus	P			P			
ISOPODS (SOW BUGS)							
Asellidae					1		
DECAPODA (CRAYFISHES)							
Astacidae							
Cambarus robustus		P			1		
Orconectes propinquus							
Orconectes virilis							
Orconectes immature					P		
Cambarus immature		P					
PELECYPODA (CLAMS)							
Sphaeriidae							
Pisidium				P			
Sphaerium							
Unionidae							
GASTROPODA (SNAILS)							
Ancylidae							
Ferrissia							
Planorbidae							
Gyraulus	P						
Helisoma							
Lymnaeidae							
Lymnaea				P			
Physidae							
Physa		P	P	P		P	P
DIPTERA (TRUE FLIES)							
Tipulidae							
Tipula							
Antocha					5		9

APPENDIX II: (continued)

WALTERS CREEK

ORGANISM	8	8A	8B	8C	9	10	13
Simuliidae					8		1
Chironomidae	P	P		P	20	95	3
Stratiomyidae		P					
Rhagionidae							
Athrix							
Tabanidae							
Chrysops							
Anthomyiidae							
Ephydridae							
Pupae unidentified					6	2	2
OLIGOCHAETA (WORMS)							
Tubificidae	P	P					
Enchytraeidae							
HIRUDINEA (LEECHES)							
Glossiphoniidae			P				
TURBELLARIA (FLATWORMS)						P	
Total Ave. # of Organisms					253	294	83
Total Taxa per Station	8	18	4	15	26	25	19

Total Taxa - 57

	MINNIEHILL CREEK			
ORGANISM	30	31	32	43
MEGALOPTERA (DOBSONFLIES, FISHFLIES, ALDERFLIES)				
Corydalidae				
Corydalus cornutus	P			
Chauliodes				
Sialidae				
Sialis				
PLECOPTERA (STONEFLIES)				
Perlidae				
Acroneuria			P	
Neophasganophora	P	P		
Paranetina				
Perlesta				
Neoperla				
Taeniopterygidae				
Taenionema				
Leuctridae				
Nemouridae				
Perlodidae				
Isoperla				
EPHEMEROPTERA (MAYFLIES)				
Ephemeridae				
Ephemera simulans				
Caenidae				
Tricorythodes				
Caenis				P
Ephemerallidae				
Ephemerella				
Leptophlebiidae				
Leptrophlebia				
Paraleptophlebia			P	
Baetidae				
Isonychia		P		
Baetis			P	P
Heptageniidae				
Stenonema	P	P	P	
S. tripunctatum				
S. fuscum				
S. nepotellum				
S. rubrum				
Stenacron	P			
Unidentified				
TRICHOPTERA (CADDISFLIES)				
Helicopsychidae				
Helicopsyche	P	P	P	P
Hydropsychidae				
Hydropsyche				
Parapsyche				
Cheumatopsyche		P		P

APPENDIX II: (continued)

	MINNIEHILL CREEK			
ORGANISM	30	31	32	43
Hydroptilidae				
Hydroptila				
Agraylea				
Mayatrichia				
Leptoceridae				
Oecetis				
Nectopsyche				
Glossosomatidae				
Glossosoma				
Rhyacophilidae				
Rhyacophila			P	
Philoptamidae				
Chimarra		P		P
Dolophilodes			P	
Polycentropodidae				
Polycentropus				
Psychomyiidae				
Psychomyia				
Lepidostomatidae				
Lepidostoma				
Limnephilidae				
Neophylax				
Hydatophylax				
Pycnopsyche				
Hesperophylax				
Limnephilus				
Psychoglypha				
Pupae (unidentified)	P			
ODONATA				
ZYGOPTERA (DAMSELFLIES)				
Agrionidae	P	P		
Coenagrioridae				
ANISOPTERA (DRAGONFLIES)				
Aeshnidae				
Libellulidae		P		
Cordulegastridae				
Gomphidae				
COLEOPTERA (BEETLES)				
Dytiscidae				
Elmidae	P	P	P	
Psephenidae				
Haliplidae				
Hydrophilidae				
Adults (unidentified)	P	P	P	P

APPENDIX II: (continued)

	MINNIEHILL CREEK			
ORGANISM	30	31	32	43
HEMIPTERA (TRUE BUGS)				
Corixidae				
Gerridae	P			P
Notonectidae				
Belostomatidae				
HYDRACARINA (MITES)				
AMPHIPODS (SCUDS)				
Taltridae				
Hyalella azteca				
Gammaridae				
Gammarus				
ISOPODS (SOW BUGS)				
Asellidae			P	
DECAPODA (CRAYFISHES)				
Astacidae				
Cambarus robustus				
Orconectes propinquus				
Orconectes virilis	P			P
Orconectes immature				
Cambarus immature			P	
PELECYPODA (CLAMS)				
Sphaeriidae				
Pisidium		P		
Sphaerium				
Unionidae	P			
GASTROPODA (SNAILS)				
Ancylidae				
Ferrissia				
Planorbidae				
Gyraulus			P	
Helisoma				
Lymnaeidae				
Lymnaea	P			
Physidae				
Physa	P	P		P
DIPTERA (TRUE FLIES)				
Tipulidae		P		
Tipula				
Antocha				
Simuliidae		P		
Chironomidae		P	P	P
Stratiomyidae				
Rhagionidae				
Athrix				

APPENDIX II: (continued)

ORGANISM	MINNIEHILL CREEK 30	 31	 32	 43
Tabanidae				
Chrysops				
Anthomyiidae				
Ephydridae				
Pupae unidentified			P	
OLIGOCHAETA (WORMS)				
Tubificidae		P		
Enchytraeidae				
HIRUDINEA (LEECHES)				
Glossiphoniidae				
TURBELLARIA (FLATWORMS)				P
Total Taxa per Station	12	15	12	11

Total Taxa - 30

APPENDIX II: (continued)

	OTHER TRIBUTARIES OF THE BIGHEAD RIVER			
ORGANISM	34	35	41	45
MEGALOPTERA (DOBSONFLIES, FISHFLIES, ALDERFLIES)				
Corydalidae				
Corydalus cornutus				
Chauliodes				
Sialidae				
Sialis				
PLECOPTERA (STONEFLIES)				
Perlidae				
Acroneuria				
Neophasganophora				
Paranetina				
Perlesta				
Neoperla				
Taeniopterygidae				
Taenionema				
Leuctridae				
Nemouridae				
Perlodidae				
Isoperla				
EPHEMEROPTERA (MAYFLIES)				
Ephemeridae				
Ephemera simulans				
Caenidae				
Tricorythodes				
Caenis				
Ephemerallidae				
Ephemerella				
Leptophlebiidae				
Leptrophlebia				
Paraleptophlebia				
Baetidae				
Isonychia				
Baetis	P	1		
Heptageniidae				
Stenonema				
S. tripunctatum	P		P	
S. fuscum				
S. nepotellum				
S. rubrum				
Stenacron				
Unidentified				
TRICHOPTERA (CADDISFLIES)				
Helicopsychidae				
Helicopsyche				

APPENDIX II: (continued)

	OTHER TRIBUTARIES OF THE BIGHEAD RIVER			
ORGANISM	34	35	41	45
Hydropsychidae				
Hydropsyche				
Parapsyche				
Cheumatopsyche		4		
Hydroptilidae				
Hydroptila				
Agraylea				
Mayatrichia				
Leptoceridae				
Oecetis				
Nectopsyche				
Glossosomatidae				
Glossosoma				
Rhyacophilidae				
Rhyacophila				
Philoptamidae				
Chimarra		1		
Dolophilodes				
Polycentropodidae				
Polycentropus				
Psychomyiidae				
Psychomyia				
Lepidostomatidae				
Lepidostoma				
Limnephilidae				
Neophylax				
Hydatophylax				
Pycnopsyche				
Hesperophylax				
Limnephilus	P			
Psychoglypha				
Pupae (unidentified)		1		
ODONATA				
ZYGOPTERA (DAMSELFLIES)				
Agrionidae		1		
Coenagrioridae	P		P	
ANISOPTERA (DRAGONFLIES)				
Aeshnidae			P	
Libellulidae		2	P	
Cordulegastridae				
Gomphidae				
COLEOPTERA (BEETLES)				
Dytiscidae				
Elmidae				
Psephenidae			P	
Haliplidae				

APPENDIX II: (continued)

	OTHER TRIBUTARIES OF THE BIGHEAD RIVER			
ORGANISM	34	35	41	45
Hydrophilidae				
Adults (unidentified)	P	3	P	P
Larvae (unidentified)	P			
HEMIPTERA (TRUE BUGS)				
Corixidae	P			P
Gerridae		2		
Notonectidae			P	
Belostomatidae			P	
HYDRACARINA (MITES)	P			
AMPHIPODS (SCUDS)				
Taltridae				
Hyalella azteca	P			P
Gammaridae				
Gammarus				
ISOPODS (SOW BUGS)				
Asellidae	P			
DECAPODA (CRAYFISHES)				
Astacidae				
Cambarus robustus				
Orconectes propinquus				
Orconectes virilis			P	
Orconectes immature				
Cambarus immature				
PELECYPODA (CLAMS)				
Sphaeriidae				
Pisidium	P			P
Sphaerium	P		P	
Unionidae				
GASTROPODA (SNAILS)				
Ancylidae				
Ferrissia			P	
Planorbidae				
Gyraulus				P
Helisoma	P			P
Lymnaeidae				
Lymnaea				P
Physidae				
Physa	P	6	P	P
DIPTERA (TRUE FLIES)				
Tipulidae				
Tipula				
Antocha				

APPENDIX II: (continued)

	OTHER TRIBUTARIES OF THE BIGHEAD RIVER			
ORGANISM	34	35	41	45
Simuliidae		2		
Chironomidae		1	P	P
Stratiomyidae				
Rhagionidae				
Athrix				
Tabanidae				
Chrysops				
Anthomyiidae				
Ephydridae				
Pupae unidentified				
OLIGOCHAETA (WORMS)				
Tubificidae		1		
Enchytraeidae				
HIRUDINEA (LEECHES)				
Glossiphoniidae				
TURBELLARIA (FLATWORMS)			P	
Total Average # of Organisms		26		
Total Taxa	14	11	12	10

APPENDIX III

Water Quality data for the Bighead River
May – Nov. 1980

NOTE: All results in mg/l except where indicated

Station	Bacteria /100 ml				Solids		pH	CA	COND	$CaCO_3$	Cl	TURB	Mg	CALC HARD	BACK GROUND BACTI		
	TC	FC	FS	PA	Total	Susp											
1	2533	$^{G}571$	$^{AG}201$	<4	268	132.2	7.92	62.3	464	232	4.3	0.69	23.7	253	4533		
3	AC483	A51	$<^{A}19$	<4		4.4	8.34	60.4	444	222	4.3	1.90	24.2	251	12373		
4	$^{A}350$	$^{A}53$	A75	<4		1.7	8.36	61.7	462	244	3.0	1.5	26.6	264	4423		
5	$^{C}1570$	93	A68	<4		3.8	8.42	59.4	441	226	3.2	2.7	24.8	251	11433		
6	$^{C}3897$	4295	A76	<4	290	180.6	8.29	65.6	483	242	3.9	12.0	26.3	272	3877		
7	A307	$^{A}59$	$^{A}35$	<4		1.9	8.41	60.7	448	242	1.5	0.93	25.5	257	1337		
8A	$^{C}2225$	$^{A}85$	A95	<4		0.8	7.83	61.5	445	249	3.7	0.78	24.1	253	6900		
8B	1900	A16	127	<4		0.8	7.99	77.0	540	304	4.8	0.80	27.7	306	10900		
8C	2000	504	96	<4		0.6	7.82	72.0	540	266	3.5	0.30	27.8	295	5300		
8	$^{A}20$	$^{<}14$	~10	<4		<0.1	7.79	72.0	516	252	4.0	1.02	29.1	300	296		
9	A1335	A85	158	<4		3.9	8.31	63.1	474	238	4.0	1.5	26.1	272	12853		
10	$^{C}1030$	260	170	<4			8.36	67.0	492		4.5	3.7	27.6	281	6800		
12	993	A200	A80	<4		3.8	8.31	62.7	461	240	3.7	2.8	26.6	263	6700		
13	AC1025	$^{A}69$	$^{A}51$	<4	296	143.0	8.36	62.8	433	238	3.9	6.7	25.5	262	6765		
14	2375	153	$^{AG}227$	<4		4.2	8.25	58.7	409	224	3.5	6.4	24.5	248	10283		
14A	$^{C}1803$	$^{C}272$	$^{AG}271$	<4	270	134.6	8.30	60.2	461	234	3.8	3.5	25.2	254	12930		
15	AC1278	A22	A54	<4	234	114.2	7.91	55.2	412	218	2.8	1.22	23.2	234	9970		
16	$<^{AC}340$	<11	$<^{A}16$	<4		254.6	8.34	64.9	427	241	5.4	1.7	25.2	266	4740		
17	1888	211	$^{G}198$	<4	288	379.4	8.28	58.5	418	225	5.0	3.7	23.7	244	13435		
19	AC200	$<^{A}15$	$^{AC}23$	<4		42.9	8.41	64.9	440	244	4.4	2.1	25.2	266	2448		

Stream BIGHEAD RIVER

Sampling Period 21/05/80 to 26/11/80

Reach

Monitoring Summary Card

Station	Dissolved Oxygen			C°	BOD$_5$			Phosphorus				Nitrogen					
								Total					FA				
	Ave	Max	Min	Temp	Ave	Max	Min	Ave	Max	Min	Sol	Kjel	Ave	Max	Min	NO$_2$	NO$_3$
1								0.017	0.025	0.009	0.004	0.41	0.012	0.025	0.005	0.004	0.45
3								0.017	0.022	0.013	0.001	0.46	0.020	0.025	0.015	0.002	0.15
4								0.009	0.010	0.007	<0.002	0.26	0.005	0.005	0.005	0.002	0.46
5								0.014	0.027	0.007	0.001	0.33	0.006	0.010	0.005	0.003	0.43
6								0.052	0.097	0.016	<0.006	0.43	<0.056	0.140	<0.005	0.005	0.88
7								0.007	0.009	0.006	0.002	0.16	<0.005	0.005	<0.005	0.001	0.55
8A								0.023	0.025	0.022	0.010	0.57	0.015	0.025	0.005	0.005	0.26
8B								0.019	0.019	0.018	0.007	0.34	0.005	0.005	0.005	0.001	0.02
8C								0.007	—	—	0.003	0.18	0.010	—	—	0.001	2.30
8								0.004	0.006	0.003	0.002	0.16	<0.006	0.010	<0.005	0.002	2.56
9								0.018	0.022	0.016	0.004	0.41	0.009	0.010	0.005	0.004	1.42
10								0.023	—	—	0.003	0.38	0.010	—	—	0.002	1.45
12								0.013	0.014	0.013	<0.001	0.30	0.008	0.010	0.005	0.003	0.47
13					2.3	—	—	0.047	0.215	0.012	0.004	0.52	<0.016	0.055	<0.005	0.004	1.14
14.					1.8	—	—	0.039	0.126	0.011	<0.004	0.50	0.016	0.025	0.005	0.005	0.32
14A								0.016	0.019	0.014	<0.002	0.33	0.019	0.030	0.005	0.004	0.44
15					1.0	—	—	0.014	0.020	0.011	<0.002	0.50	<0.008	0.025	<0.005	0.002	<0.02
16					4.2			0.139	0.800	0.001	<0.004	1.01	<0.017	0.040	<0.005	0.004	0.74
17					1.0			0.187	1.180	0.007	<0.014	0.86	<0.028	0.055	<0.005	0.008	0.60
19					1.8			0.079	0.162	0.005	0.002	0.56	0.005	0.005	0.005	0.003	0.78

BIGHEAD RIVER
21/05/80 — 25/11/80

NOTE: All results in mg/l except where indicated

Station	Bacteria /100 ml				Solids		pH	COND	Cl	TURB	CaCO$_3$	CA	Mg	CALC HARD	BACK GROUND BACTI			
	TC	FC	FS	PA	Total	Susp												
20	^{AC}245	^{A}104	<^{A}18	<4		2.1	8.29	468	4.7	2.02	254	68.5	12.2	277	2230			
21	2100	100	^{A}60	<4			8.48	468	6.0	2.5		65.0	24.6	264	9000			
22	2485	<288	104	<4		6.1	8.30	456	5.1	3.5	249	66.1	25.1	269	12160			
22A	9750	^{AG}310	^{A}117	<4		1.8	8.44	293	5.2	1.4	271	70.7	26.7	287	15000			
24	^{AC}850	182	^{A}63	<4		2.7	7.66	466	5.7	1.38	249	66.9	25.0	270	12400			
25	^{C}923	91	^{A}55	<4		254.7	8.00	372	3.12	4.58	208	56.5	20.1	224	7747			
26	^{A}455	^{A}22	64	<4		710	7.84	340	1.6	5.7	192	52.2	18.5	206	10990			
27	^{AC}1293	^{A}62	81	<4		6.2	7.64	528	7.8	1.17	273	73.3	26.6	293	9163			
28	260	430	^{A}70			272.6	7.66	276	12.0						1040			
32	^{C}240	^{A}30	^{A}50												5000			
33	^{C}2345	258	^{A}141	<4			8.25	422	4.3	6.3		63.3	26.4	264	12828			
34	^{C}1540	^{A}224	^{A}180	<4	292	126.8	8.15	454	8.3	4.5	250	66.0	25.1	268	12748			
38	^{C}865	220	^{AG}24	<4		1230.9	8.17	413	8.5	4.8	232	61.0	25.7	258	8305			
38A	^{C}1545	^{A}193	^{G}375	<4		141.4	8.09	586	7.8	5.9	258	76.3	21.9	281	6813			
39	1200	170	^{A}20	4			8.34	470	4.5	4.0		62.0	26.6	265	23000			
41	^{C}750	^{A}79	^{A}61	<4			7.95	670	18.0	15.0		93.5	28.8	352	21150			
42	1900	257	^{A}97	<4		569.8	8.18	426	5.4	2.9	231	61.0	26.1	260	19133			
43	^{C}2162	336	^{G}438	<4	302	514.7	8.17	412	7.2	3.3	227	64.9	23.3	258	11520			
44	^{C}1915	332	^{AG}457	<4		33.1	8.26	439	4.2	2.8	233	61.0	26.1	260	18175			

Stream BIG HEAD RIVER

Sampling Period 21/05/80 to 25/11/80

Reach

Monitoring Summary Card

Station	Dissolved Oxygen Ave	Dissolved Oxygen Max	Dissolved Oxygen Min	C° Temp	BOD$_5$ Ave	BOD$_5$ Max	BOD$_5$ Min	Phosphorus Total Ave	Phosphorus Total Max	Phosphorus Total Min	Phosphorus Sol	Nitrogen Kjel	Nitrogen FA Ave	Nitrogen FA Max	Nitrogen FA Min	Nitrogen NO$_2$	Nitrogen NO$_3$
20					1.7			0.027	0.080	0.011	0.004	0.49	0.006	0.010	0.005	0.003	0.62
21								0.031			0.005	0.56	0.005			0.001	0.35
22					2.2			0.042	0.128	0.014	0.003	0.73	0.015	0.040	0.005	0.006	0.41
22A								0.019	0.019	0.019	0.003	0.52	0.008	0.010	0.005	0.003	0.48
24					2.0			0.040	0.070	0.024	0.012	0.64	0.030	0.055	0.010	0.009	0.20
25					3.2			0.162	0.510	0.022	0.026	1.12	0.052	0.115	0.005	0.013	<0.21
26					3.4			0.254	0.820	0.040	0.038	1.59	0.056	0.110	0.010	0.010	<0.10
27								0.030	0.037	0.021	0.013	0.61	0.018	0.025	0.010	0.017	2.69
28					6.4			0.620			0.051	2.90	0.020			0.071	1.05
32 —																	
33					2.1			0.034	0.084	0.015	0.004	0.44	0.029	0.035	0.020	0.008	0.60
34					2.6			0.050	0.215	0.005	<0.005	0.75	<0.159	0.875	<0.005	0.010	0.09
38					5.2			0.752	2.950	0.014	0.027	2.73	0.028	0.040	0.015	0.024	1.34
38A					1.0			0.073	0.240	0.006	0.011	0.36	0.025	0.070	0.005	0.008	1.21
39								0.017			0.005	0.36	0.020			0.005	0.59
41								0.037			0.003	0.67	0.035			0.002	0.02
42					4.0			0.356	1.340	0.017	0.014	1.22	0.028	0.040	0.015	0.012	0.68
43					5.6			0.316	1.540	0.006	0.010	1.17	0.011	0.020	0.005	0.011	1.19
44					1.8			0.045	0.130	0.015	0.006	0.43	0.026	0.045	0.010	0.008	0.64

NOTE: All results in mg/l except where indicated

Station	Bacteria /100 ml				Solids		pH	CA	Mg	CALC HARD.	TURB	Cl	CaCO3	COND	BACK GROUND BACTI		
	T C	F C	F S	P A	Total	Susp											
45	GC 10183	16 1265	1500	<4	228	159.8	7.95	66.9	23.6	264	13.5	6.4	222	467	48775		
46					284	268	8.45	60.5	20.6	236			229.				
47	1930	169	G 198	<4	280	133.5	8.24	56.4	22.9	224	60.7	4.5	215	407	10590		
48	C 985	193	A 231	<4		10.0	8.32	57.9	238	243	4.4	5.2	210	438	14880		

Stream BIGHEAD RIVER

Sampling Period 21/05/80 to 25/11/80

Reach..............

Monitoring Summary Card

Station	Dissolved Oxygen			C° Temp	BOD5			Phosphorus				Nitrogen					
								Total			Sol	Kjel	FA			NO2	NO3
	Ave	Max	Min		Ave	Max	Min	Ave	Max	Min			Ave	Max	Min		
45					4.8			0.134	0.440	0.017	0.015	1.10	0.035	0.035	0.005	0.005	0.05
46								0.016			0.003	0.34	0.020			0.004	0.42
47					4.6			0.117	0.380	0.011	<0.015	0.71	<0.026	0.070	<0.005	0.012	0.60
48								0.028	0.066	0.014	0.006	0.54	0.021	0.055	0.010	0.010	0.54

Ministry of the Environment
Ontario

Water Quality data collected during a heavy rainfall event. **Monitor Data Ca**

Stream Bighead River Station .... Description Flood conditions July 15, 198

Station numbers.	D O (mg/l)	Temp °C	BOD5 (mg/l)	Bacteria / 100 ml			Phosphorus		Nitrogens				pH	Turbidity	Susp. Solids	Conductivity	Chloride	
				Total	Fecal	Strep.	Total	Sol.	F. A.	Kjel.	Nitrite	Nitrate						
13			2.3				.215	.004	.055	1.60	.011	.85	8.12	2.4		275	2.0	
14			1.8				.126	.010	.025	.90	.013	.45	8.02	19.0		302	3.5	
15			1.0				.020	.001	.025	.58	.004	.04	8.16	2.3		374	4.0	
16			42				.800	.019	.040	4.40	.020	.64	7.89			250	4.0	
17			1.0				1.180	.074	.055	3.50	.035	1.01	7.92		849.7	306	8.5	
19			1.8				.162	.005	.005	1.42	.009	.55	8.19		80.2	313	3.5	
20			1.7				.080	.002	.010	.89	.009	.47	8.18	6.20		375	3.5	
22			22				.128	.005	.040	1.52	.018	.53	8.13	11.0		386	4.5	
24			20				.070	.016	.035	.82	.022	.30	7.80	2.40		352	6.5	
28			64				.62	.051	.020	2.9	.071	1.05	7.66		272.6	276	12.0	
33			2.1				.084	005	.025	.61	.011	.64	8.19	16.0		328	3.5	
34			28				.215	.004	.005	1.25	.015	.35	7.81		129.1	227	5.0	
38			52				240	.034	.070	.60	.016	.47	8.20		222.5	386	4.5	
38a			1.0				2.950	.099	.035	9.70	.070	3.60	7.80		2453.1	270	19.5	
42			4.0				1.34	.022	.040	3.70	.029	1.03	7.86		1135.9	317	8.0	
43			5.6				1.540	.044	.020	4.70	.037	.98	7.86		1251.8	228	8.5	
44			1.8				.130	.014	.045	.76	.013	.74	8.17		62.8	372	4.0	
45			4.8				.440	.058	.055	2.00	.063	.84	7.73		224.3	250	7.0	
47			4.6				.380	.055	.040	1.80	.054	.72	7.82		134.7	324	7.0	

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